**Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**The Scientific Method: Exploring Experimental Design**

***Come Fly With Us***

**Background:** This assignment is intended to be a quick and easy guide to the methods scientists use to solve problems. You are going to start by making a model helicopter with the attached instructions. You will be given a problem question, and it is your job to write a suitable hypothesis. Remember, your hypothesis should be a possible answer to the problem question and it should be based upon what you already know about a topic.

**Problem/Question:** How will changing the direction that the paper helicopter blades are folded affect the “flight” of the helicopter?

**Materials:** copy of helicopter model, scissors, pen or pencil

**Procedure:**

1. Read the problem question and respond with an appropriate hypothesis.

**If-Then Hypothesis:** If helicopter blades \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_,

(Independent Variable)

then the helicopter will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(Dependent Variable)

2. Once you have made your hypothesis, you should test it for accuracy.

a. Using scissors cut out your helicopter and follow the directions for folding it.

b. Then, hold the helicopter by the “T” level with the bottom of the 5th concrete block from the ceiling.

c. Drop the helicopter and note whether it spins clockwise or counterclockwise.

d. Repeat this test several times.

e. Refold the blades so that the square on blade Y shows when you look down on top of the helicopter.

f. Repeat steps b and c several times.

**Analysis:**

You have just performed an experiment. Experiments involve changing something to see what happens. In this case, you refolded the helicopter blades. You made this change on purpose to learn about its effect on the flight of the helicopter. The parts of an experiment that change are called *variables*.

There are two kinds of variables in an experiment. One, the independent variable, is the one you changed on purpose. The other, the dependent variable, is the one that happened as a result of the independent variable. In order to make a fair test, you only changed one aspect of your experiment. By only changing one variable, you know that your change is what caused the helicopter to respond in the way it did.

To have a fair test, you also need a *control*, or a standard for comparison. A control for the helicopter experiment would be an “unchanged” helicopter against which you could compare the results. In this experiment, you could make another helicopter with blades that remain unchanged. By using both helicopters each time, you could compare the results to be more accurate.

It is important to note that in some experiments, it is impossible to have a control that is completely unchanged. For example, let us say you are trying to determine the effect of light from different light sources on plant growth. The control plant needs some kind of light in order to live through the experiment. So, you have to choose one light source — possibly normal sunlight — to be the standard of comparison.

After you refolded the blades of the helicopter, you dropped the helicopter several times and observed the results. These repeated trials enable you to be more confident of your results. If you conducted your experiment only once, the results could be due to an error or a chance event, such as a draft. But, when you repeat your experiment many times and each time you achieve similar results, you can be more confident that your findings are not due to an error or chance.

**Conclusion Questions:**

1. In the helicopter experiment, what was the independent variable?
2. What was the dependent variable?
3. List three things you should try to keep constant each time you try this experiment.

a.

b.

c.

1. Read the following paragraph and answer questions 5-11:

*Alicia wanted to know if adding mass to her paper helicopter would affect how long it would stay in the air. She predicted that adding some mass would help to stabilize the helicopter and keep it in the air longer than a helicopter without extra mass. She experimented with different numbers of paper clips attached to her helicopter.*

1. What is the problem question in Alicia’s experiment?
2. What is Alicia’s hypothesis?
3. What is her independent variable?
4. What is her dependent variable?
5. What should her constants be?
6. What can she use for a control?
7. Why should Alicia retest her experiment between 5-10 times?

